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Deposit-Refund on Labor: A Solution to Equilibrium Unemployment?

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Abstract

The paper studies the employment effects of a deposit-refund scheme on labor in a simple search-theoretic model of the labor market. It is shown that if a firm pays a deposit to the government when it fires a worker, to be refunded when it employs the same or another worker, the vacancy rate increases and the unemployment rate declines. However, the scheme introduces rigidities in the labor market that may be undesirable in countries wanting to liberalize their labor markets.

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I. INTRODUCTION

Some people return empty bottles to the store because they find littering and nonrecycling unacceptable from an environmental point of view. Many people, however, are motivated to return the bottles only because there is money to be made in the form of a deposit that is refunded. The literature on environmental economics has shown that these deposit-refund schemes are efficient instruments to deal with the negative environmental externalities resulting from illicit dumping.[2] If unemployment is considered to create negative externalities,[3] one could argue for using a deposit-refund system in the labor market. Why not have the firm pay a deposit when it fires a worker, to be refunded when it (re-) hires that or another worker?

A deposit-refund scheme on labor is essentially a specific tax on firing an employee matched by a specific subsidy on hiring a (new) worker. Schemes that rely solely on hiring subsidies to boost employment may encourage firms to generate high labor turnover—assuming that the subsidy exceeds the recruitment and training costs to the firm—with a view to securing a net gain. Fay (1996) argues that close monitoring in employment-subsidy programs is important to make sure that subsidies are not used to replace subsidized workers whose subsidy has ended nor to recruit workers for recently created temporary vacancies. By seeking a policy mix consisting of both a "carrot" and a "stick," one can contain the budgetary implications of hiring subsidies; firing taxes reduce firms' incentives to lay off workers and generate government revenues to (partly) finance public spending on hiring subsidies.

The current paper analyzes the long-run unemployment effects of deposit-refund schemes on labor. To this end, a modified version of Pissarides' (1990) search-theoretic model of the labor market is employed. This framework allows for flows in the labor market from the creation of new jobs and the (exogenous) destruction of superfluous jobs. It assumes a search process in which firms offering vacancies and unemployed job-seeking workers are brought together in a stochastic fashion. In this type of model, vacancies and unemployment occur simultaneously in equilibrium. Pissarides' model thus differs radically from the aggregate (classical) labor market model in which only unemployed workers (vacancies) are observed when the wage is above (below) its equilibrium value. The model features a search externality which is represented by agents' contact probabilities as a function of labor market tightness: the presence of an additional firm with a vacancy makes it easier for workers to find jobs but harder for firms to fill vacancies. Similarly, an additional unemployed worker makes it more difficult for workers to locate jobs but easier for vacancies to be filled with workers.

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[2] See, among others, Massell and Parish (1968), Bohm (1981), and Fullerton and Kinnaman (1995).

[3] Phelps (1997) claims that unemployment is associated with negative externalities such as crime, poor health, and cultural deprivation.

So far, the literature on unemployment policy has not studied deposit-refund systems in the context of labor markets. However, there exists a substantial literature on hiring subsidies, on the one hand, and firing costs on the other hand. Informal discussions on the beneficial employment effects of hiring subsidies can be found in Phelps (1997), Fay (1996), and OECD (1994). The earlier theoretical literature on employment subsidies, which assumes a clearing labor market, stresses their employment-enhancing effect. Recently, Millard and Mortensen (1997) and Mortensen and Pissarides (1998)—employing a search-theoretic model of the labor market—have shown that hiring subsidies reduce the duration of unemployment but have an ambiguous effect on the unemployment rate.[4] Experiments with employment subsidies in the United States and Italy—as reported in Woodbury and Spiegelman (1987) and Felli and Ichino (1988)—have generally been successful in increasing employment. However, there has been little analysis of schemes taking into account the budgetary consequences of subsidy provision. A notable exception is the work of Snower (1994) and Orszag and Snower (1996), who propose a "benefit transfer program" in which long-term unemployed people can transfer part of their unemployment benefits into employment vouchers which can be used to subsidize the firms hiring them.

The theoretical literature on firing costs—with central contributions including Bertola (1990, 1992), Bentolila and Bertola (1990), and Booth (1997)—generally finds that employment protection provisions reduce the variation of employment over the business cycle, but the effect on the average level of employment is ambiguous. Firing costs create disincentives for firms wanting to fire workers but also discourage hiring because of the discounted costs of possible firing in the future. As a result, labor demand is reduced during booms and increased in slumps relative to a situation without firing costs. Bertola (1992) shows that when discount and attrition rates are positive, the average employment effect of firing costs depends on its effect on the marginal product of labor (which is negative), as well as the relative slopes of the labor demand curve in booms and slumps. He argues that if hiring and firing cycles are long—in which case attrition and discount rates are large and thus the present discounted value of firing costs small—employment may increase.[5] No consensus has been reached yet in the empirical literature on the employment effects of firing costs (see Hunt, 1994).

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[4] These papers extend Pissarides' (1990) framework by endogenizing the job destruction process. Because their analytical framework yields indeterminate employment effects of hiring subsidies, the current paper employs the much simpler Pissarides model, which assumes an exogenous unemployment hazard. Accordingly, the present model cannot allow for the effect of firing taxes on firms' incentives to lay off workers.

[5] Bentolila and Bertola (1990) allow for uncertainty in firms' business conditions and find positive employment effects in their numerical simulations even for very small attrition and discount rates. However, Lazear (1990) and Burda (1992)—the latter employing a search theoretic framework—derive negative employment effects of firing costs.

The model at hand shows that deposits and refunds on labor push up economy-wide wages, increase the vacancy rate, and reduce the equilibrium rate of unemployment. Intuitively, the scheme provides an implicit subsidy (i.e., the capital value of the deposit) to firms hiring new employees. However, the model gives a very stylized description of the labor market; employees work (full time) during their entire life, they do not voluntarily quit jobs, and workers are either employed or unemployed in which case they are looking for a job. As the discussion section argues, if firms can freely set working hours, deposit-refund schemes on labor are likely to induce firms experiencing bad business conditions to impose shorter working hours on their workforce as a substitute for firing them. Accordingly, the variance of employment over the business cycle is stabilized. Some observers may claim that this contributes to undesirable rigidities in the labor market.

The paper proceeds as follows. Section II sets out the search-theoretic model of the labor market which incorporates a deposit-refund system on labor. Subsequently, firm behavior, worker behavior, and wage setting are described. Section III derives the comparative statics of a change in the deposit rate and the optimal-deposit rate. Section IV discusses some implications of a deposit-refund scheme and reflects on its applicability as a policy instrument to deal with unemployment. Section V concludes.

II. A Search Model of the Labor Market

Suppose that there is a fixed labor force, L, of which a fraction u is unemployed per unit of time.[6] The flow into unemployment originates from an exogenous job destruction process that causes a proportion s of occupied jobs to dissolve. Only unemployed laborers search for a job, thus excluding on-the-job search by workers. Likewise, the firm is not searching for workers to replace (unsatisfactory) incumbent workers. Vacancies are created by new firms or by incumbent firms reopening previously destroyed jobs.

At each instant of time, uL unemployed workers and vL vacancies on offer engage in a stochastic matching process, where v is the vacancy rate. The number of successful matches depends on the number of unemployed workers, $U \equiv uL$, and the total number of vacancies, $V \equiv vL$, according to the following matching function:

$$xL = G(U, V), \qquad G_U > 0,\ G_{UU} < 0,\ G_V > 0,\ G_{VV} < 0,\ G_{UV} > 0, \tag{1}$$

[6] This section builds on Pissarides (1990), which is amended to allow for a deposit-refund scheme on labor.

where xL is the total number of matches, x denotes the matching (or hazard) rate, and $G(.,.)$ is a linearly homogeneous function. By defining $g \equiv xL/V = x/v$, the matching function can be rewritten to yield $g = g(\theta)$, with $g'(\theta) < 0$.[7] The probability that a firm finds a worker in the time interval dt is given by $g(\theta)dt$, where $\theta \equiv V/U$ denotes the vacancy-unemployment rate, which is a measure of labor market tightness. Then, the expected duration of a vacancy is given by $1/g(\theta)$. Similarly, $f(\theta) \equiv \theta g(\theta)$ is the probability of an unemployed worker finding a job so that $1/f(\theta)$ is the expected duration of an unemployment spell.

In the aggregate, unemployment evolves according to the difference between the average number of unemployed workers who find a job and the average number of workers entering the unemployment pool, $\dot{u}L\,dt = f(\theta)uL\,dt - s(1-u)Ldt$, where a dot denotes a time derivative. This yields the following steady-state rate of unemployment:

$$u = \frac{s}{s + f(\theta)}. \tag{2}$$

A. Firm Behavior

Assume that there are many risk-neutral firms, each of which has one job that is either filled or vacant. If the job is filled, the representative firm rents physical capital, k, at the constant rate of interest,[8] r, to produce output according to a constant-returns-to-scale production function, $F(k,1)$, which satisfies the usual properties. If the job is vacant, the firm actively searches for a suitable worker and is incurring search cost, γ_0, per unit of time.

Suppose that a firm hiring a worker receives a fixed one-off subsidy of b from the government, but when it fires that worker it must pay a tax of b. This is like a variant—in fact, the reverse—of a cash-refund scheme on bottles where consumers have to pay a fixed amount on buying a filled bottle and receive a refund (set at the same rate) when the empty bottle is properly disposed of.[9] In the model, it is assumed that workers do not voluntarily quit jobs (in which case the firm would not need to pay a firing tax).

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[7] Job-seeking workers flow out of the unemployment pool according to a Poisson process with rate x/v.

[8] Assuming a small open economy for which the world rate of interest is given.

[9] In case of a deposit-refund on labor, the firm is the buyer of the services of the nonreproducible commodity "labor." Then, the firm receives a subsidy if it hires one unit of labor while in the case of bottles the firm supplies the reproducible commodity "bottled beverages" at a fixed charge.

Let J_F and J_V denote the present value of profits of a firm with a filled job and a vacancy, respectively. Assume perfect capital markets so that firms can borrow freely at the market rate of interest. Then, the following arbitrage equation can be derived for a firm having a vacancy:

$$rJ_V = -\gamma_0 + g(\theta)\left[J_F + b - J_V\right]. \tag{3}$$

Equation (3) says that the capital cost of the firm, rJ_V, should equal the firm's expected return on investment, which consists of two parts: (i) the fixed-search costs that are incurred per time unit, and (ii) the expected capital gain when it finds a worker. The latter is equal to the sum of the gain in present value from filling the vacancy (i.e., J_F-J_V) *and* the subsidy payment received from the government, weighted by the probability of finding a suitable candidate. The number of firms/jobs is determined by the zero-profit condition—free entry and exit of firms will occur until all profit opportunities from new vacancies are equal to zero. This implies the following expression for the present value of an occupied job:

$$J_V = 0 \quad \Rightarrow \quad J_F = \gamma_0/g(\theta) - b. \tag{4}$$

Equations (3)–(4) show that b acts like an *implicit subsidy* to firms with a vacancy: the expected search costs, $\gamma_0/g(\theta)$, are reduced by the subsidy payment received from the government.

For a firm with a filled job, the steady-state arbitrage equation reads as follows:

$$rJ_F = F(k,1) - (r+\delta)k - w - s\left[J_F + b\right], \tag{5}$$

where w denotes the wage rate and δ is the rate of depreciation. The left-hand side of equation (5) represents the expected return on an occupied job, which is composed of the surplus created in production and the expected capital loss owing to job destruction (i.e., $s(J_F+b)$). If the job is destroyed, the firm not only loses the value of the occupied job, but must also pay back the deposit on its worker to the government. Since the job destruction rate, s, is exogenous, the firm can do nothing to reduce the probability of an adverse job-destroying shock.

The firm chooses the amount of capital it wants to rent such that the value of the firm is maximized:

$$\underset{\{k\}}{\text{Max}} \; (r+s)J_F \equiv F(k,1) - (r+\delta)k - w - sb. \tag{6}$$

This yields the marginal productivity conditions for capital and labor:

$$F_k(k,1) = r + \delta, \tag{7}$$

$$F_N(k,1) - w = \frac{(r+s)\gamma_0}{g(\theta)} - rb, \tag{8}$$

where N is employment and subscripts denote partial derivatives. From equation (7) it follows that the optimal size of the firm is determined by the rental charge on capital goods. Equation (8) shows that labor receives less than its marginal product, owing to the positive search costs.[10] However, the capital value of the deposit acts like a subsidy on the use of labor.

B. Worker Behavior

Workers are homogeneous, live forever, and are risk-neutral. Therefore, they care only about the expected discounted value of their income. It is assumed that each worker with a job supplies one unit of labor inelastically. Let Y_E and Y_U denote the present-discounted value of the expected stream of income of, respectively, an employed worker and an unemployed worker. An unemployed worker receives an exogenously given income, z, during his/her search and expects to move into a job with probability $f(\theta)$.[11] Then, the following steady-state arbitrage condition can be derived for a worker without a job:

$$rY_U = z + f(\theta)\left[Y_E - Y_U\right]. \tag{9}$$

The arbitrage condition says that the return on human capital of an unemployed worker during search—the reservation wage[12]—should equal expected income which consists of the imputed value of leisure and the capital gain from finding a job.

A worker with a job earns a wage, w, and loses that job at an exogenous rate s. Then, in steady state, permanent income of an employed worker, rY_E, should equal expected income, which exceeds wage income to compensate for the risk of becoming unemployed:

$$rY_E = w - s\left[Y_E - Y_U\right]. \tag{10}$$

Solving equations (9) and (10) yields expressions for Y_E and Y_U:

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[10] Note that $(r+s)J_F = F_N(k,1) - w - sb$. Equation (8) is obtained by using this result in (4).

[11] This may represent the imputed value of leisure or income earned in the hidden economy.

[12] This could also be interpreted as permanent income; the amount the unemployed worker can consume without running down his/her capital.

$$rY_E = \frac{r(w-z)}{r+s+\theta g(\theta)} + rY_U, \quad rY_U = \frac{(r+s)z + \theta g(\theta) w}{r+s+\theta g(\theta)}. \tag{11}$$

In a meaningful equilibrium, wages exceed the imputed value of leisure. Consequently, employed workers have a higher permanent income than unemployed workers.

C. Wage Setting

When an unemployed worker and a firm offering a vacancy meet, a pure economic rent is created by the encounter, which is equal to the sum of the expected (net) search costs of the worker and the firm. Upon separation this rent will be lost. The division of the rent of a particular firm-worker pairing i is a matter of bargaining over the wage rate, w_i. Using the Nash bargaining solution, the wage rate is set such that the weighted sum of the worker's and firm's net returns is maximized taking behavior in the rest of the labor market as given:

$$\underset{\{w_i\}}{\text{Max}}\ \Omega \equiv \beta \log\left[Y_E^i - Y_U\right] + (1-\beta)\log\left[J_F^i + b - J_V\right], \tag{12}$$

where the coefficient β $(0 \leq \beta \leq 1)$ can be interpreted as a measure of the worker's bargaining strength and Y_U and J_V are the "threat points" of the worker and the firm, respectively. The rent-sharing rule derived from (12) is given by:

$$\frac{Y_E^i - Y_U}{J_F^i + b - J_V} = \frac{\beta}{1-\beta}. \tag{13}$$

This yields the following wage equation for worker i:[13]

$$w_i = (1-\beta) rY_U + \beta\left[F_N(k_i, 1) + rb\right]. \tag{14}$$

In symmetric equilibrium, each firm with an occupied job chooses the same capital stock, that is, $k=k_i$. Accordingly, all workers are equally productive so that the wage rate is the same for all worker-firm pairs, $w=w_i$. Using equations (13), (9), and (14), the reservation wage can be written as $rY_U = z + \beta\theta\gamma_0/(1-\beta)$. Now, by combining this with equation (4), the aggregate wage equation follows:

$$w = (1-\beta)z + \beta\left[F_N(k,1) + rb + \theta\gamma_0\right]. \tag{15}$$

[13] Substituting the arbitrage equation for worker i, i.e., $rY_E^i = w_i + s(Y_U - Y_E^i)$, and the expected capital gain to firm i of filling a vacancy, i.e., $(r+s)J_F^i = F_N(k_i, 1) - w_i - sb$, yields equation (14).

The economy-wide wage is a weighted average of the imputed value of leisure and the firm's surplus, which consists of the marginal productivity of labor, the expected search costs that are saved if a deal is struck, and the implicit subsidy on labor. Accordingly, the deposit rate pushes economy-wide wages up.

III. Model Solution

A. Market Equilibrium and Government

The full model can be summarized by equations (2), (7), (8), and (15). The endogenous variables of the model are u, k, w, and θ. For a fixed capital stock, the model can be solved in a recursive fashion. Equation (7) shows that the rate of interest determines the optimal size of the firm. Given the capital stock, equations (8) and (15) yield equilibrium values for θ and w, and θ, in turn, determines the equilibrium rate of unemployment (see equation (2)). Because the rate of interest is assumed to be fixed, the wage rate is the only price variable in the model.

The analysis so far has implicitly assumed that the government finances the deposit-refund system through lump-sum taxes on households. The government cannot issue debt and does not provide unemployment benefits to workers.[14] At introduction, all firms having a filled job receive b from the government, so that a lump-sum tax of $T(0)=(1-u)Lb>0$ is needed to balance the government budget at time zero. Once the deposit-refund system is operational, job destruction leads to net government receipts, $s(1-u)Lb$, and new job matches cause net government outlays of $f(\theta)uLb$. Using equation (2), it can be easily shown that the deposit-refund system is budgetary neutral in the steady state.

B. Comparative Statics

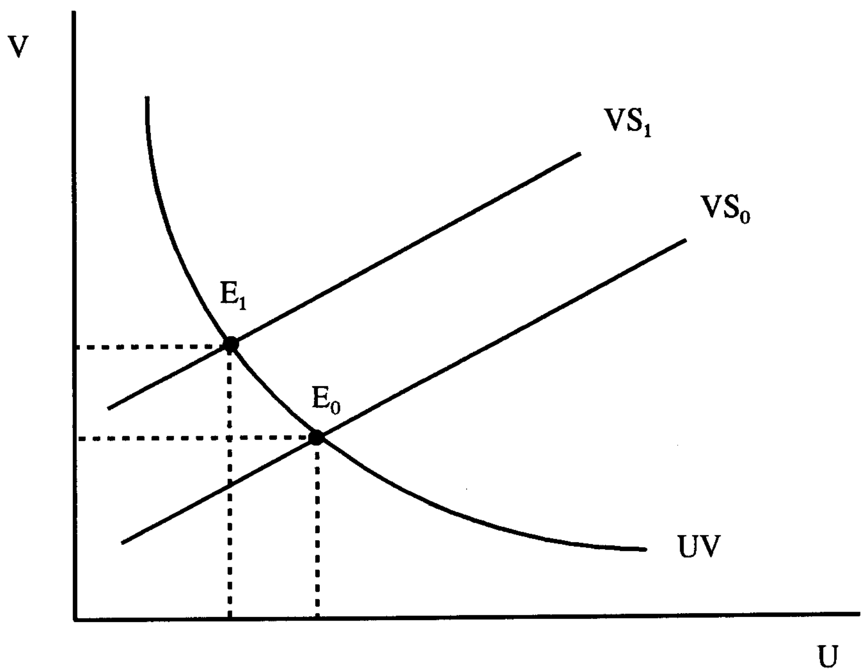
To study the comparative static effects the model can be compressed to two schedules in the unemployment-vacancy space (see Figure 1). The *UV curve*—also known as the Beveridge curve[15]—implies a negative relationship between the vacancy rate and the unemployment rate: if there are many vacancies the unemployed can find a job more easily. Loglinearizing equation (2), using $\theta \equiv V/U$, yields the following equation:

$$\frac{dv}{v} = \beta_S \frac{ds}{s} - \beta_U \frac{du}{u}, \tag{16}$$

[14] An interesting extension of the model would be to allow for distortionary taxes or debt creation to finance the deposit-refund scheme. This is left for further research.

[15] See Blanchard and Diamond (1989) for further details on the Beveridge curve.

Figure 1. Deposit-Refund and Labor Market



where β_S and β_U are defined as:

$$\beta_S \equiv \frac{1-u}{(1-u)(1-\eta(\theta))}>0, \quad \beta_U \equiv \frac{u+(1-u)\eta(\theta)}{(1-u)(1-\eta(\theta))}>0, \tag{17}$$

and $\eta(\theta)\equiv G_U/f(\theta)$ is the absolute value of the elasticity of the $g(\theta)$ function (with $0<\eta(\theta)<1$). Note that $s/U>1-\eta(\theta)$ so that $\beta_U>0$ and thus the UV curve is downward sloping. The position of the UV curve is unaffected by the existence of a deposit-refund scheme on labor. However, an increase in the job separation rate shifts the UV curve to the right.

In order to derive the *VS curve*—which represents the supply of vacancies for various equilibrium rates of unemployment—equation (15) is substituted in equation (8) to obtain:

$$(1-\beta)\left[F_N(k,1) - z + rb\right] - \left(\frac{r+s+\beta\theta g(\theta)}{g(\theta)}\right)\gamma_0 = 0. \tag{18}$$

Substituting $g(\theta)=s(1-u)/\theta u$ (from (2)) in equation (18), using $\theta \equiv v/u$, yields the VS curve:

$$(1-\beta)\left[F_N(k,1) - z + rb\right] = \gamma_0 v\Delta, \quad \Delta \equiv \left[\frac{r+s}{s(1-u)} + \frac{\beta}{u}\right] > 0. \tag{19}$$

It can be loglinearized as follows (leaving all exogenous variables other than the deposit rate unchanged):

$$\frac{dv}{v} = \alpha_U \frac{du}{u} + \left(\frac{\omega_B}{1+\omega_B-\omega_Z}\right)\frac{db}{b}, \tag{20}$$

where $\omega_B \equiv br/F_N > 0$, $\omega_Z \equiv z/F_N > 0$, and the slope of the VS curve is given by:

$$\alpha_U \equiv \frac{1}{\Delta}\left[\frac{\beta}{\mu} - \left(\frac{r+s}{s}\right)\frac{u}{(1-\mu)^2}\right] > 0, \tag{21}$$

if β is not too small. This is likely to be satisfied in an advanced economy (see Pissarides, 1990), where workers are organized in unions. For a given unemployment rate, an increase in the deposit rate increases the vacancy rate as long as $b>0$.[16] In terms of Figure 1, the VS curve shifts up and to the left, and the equilibrium moves from E_0 to E_1. Given the increased vacancy rate, unemployed workers find it easier to locate a job, and hence the expected duration of an unemployment spell falls, as does the unemployment rate. Intuitively, the interest earned on the deposit during the time the firm employs a worker acts as an implicit subsidy on hiring a new worker after separation.

C. Efficiency and the Optimal Deposit Rate

The search model features trading externalities, implying that the decentralized market outcome without policy intervention is below the socially optimal outcome. This section derives the optimal deposit-refund rate in the steady state. To keep matters simple, it is assumed that the hiring subsidy and firing tax are of equal magnitude.

Social welfare is defined as the present discounted value of gross output minus the sum of the social costs of employment (i.e., forgone leisure), zN, search costs of hiring firms, $\gamma_0 V$, and (gross) investments, I:

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[16] At introduction, when $b=0$ initially, the deposit-refund scheme does not affect the employment/unemployment rate but reduces net wages if the system is financed by lump-sum taxes.

$$\Lambda(t) \equiv \int_0^\infty \left[F(K(t),N(t)) - zN(t) - \gamma_0\theta(t)(L(t)-N(t)) - I(t) \right] e^{-rt}\,\mathrm{d}t, \tag{22}$$

where $N \equiv (1\text{-}u)L$ denotes aggregate employment, $K \equiv \sum_i k_i$ is the aggregate capital stock, and $V \equiv \theta(L\text{-}N)$ denotes aggregate vacancies. The social planner maximizes equation (22), subject to the employment constraint $\dot{N} = g(\theta)\theta(L-N) - sN$, and the capital accumulation constraint, $\dot{K} = I - \delta K$. The government's problem can be solved using Pontryagin's maximum principle, which yields the following optimality conditions:

$$F_K(\hat{k}) - (\delta + r) = 0, \tag{23}$$

$$F_N(\hat{k}) - z + \hat{\theta}\gamma_0 - \left[s + \hat{\theta}g(\hat{\theta})\right]\lambda = r\lambda - \dot{\lambda}, \tag{24}$$

$$\lambda g(\hat{\theta})\left[1 - \eta(\hat{\theta})\right] - \gamma_0 = 0, \tag{25}$$

where λ is the co-state variable of the employment constraint, $\hat{k}$ is the firm's capital-labor ratio, and the hats indicate socially optimal values. The condition for the capital stock, equation (23), is similar to equation (7), reflecting the optimality of private investment decisions. Equations (24) and (25) can be written to obtain the steady-state social optimum (with $\dot{\lambda}=0$):

$$F_N(\hat{k}) - z = \left[\frac{\eta(\hat{\theta})g(\hat{\theta})\hat{\theta} + r + s}{g(\hat{\theta})\left[1 - \eta(\hat{\theta})\right]}\right]\gamma_0 \equiv \Gamma^S(\hat{\theta},\eta)\gamma_0. \tag{26}$$

The steady-state symmetric market condition is as follows:

$$F_N(\hat{k}) - z + rb = \left[\frac{\beta g(\theta)\theta + r + s}{g(\theta)(1-\beta)}\right]\gamma_0 \equiv \Gamma^M(\theta,\beta)\gamma_0. \tag{27}$$

Matching the two equations yields:

$$rb = \gamma_0\left[\Gamma^M(\theta,\beta) - \Gamma^S(\hat{\theta},\eta)\right]. \tag{28}$$

If the Hosios (1990) condition is satisfied (i.e., $\eta(\theta)=\beta$), the social optimum is obtained in which all search externalities are fully internalized. Hence, the government should choose a zero optimal deposit rate, $rb=0$, so that $\hat{\theta}=\theta$.[17] However, if η is sufficiently low (i.e., $\eta<\beta$), implying that firms at the margin cause fewer spillovers to other firms than workers cause to other employees, equilibrium unemployment is above the efficient level. In that case, a positive deposit rate is needed—thereby implicitly subsidizing firms—to yield a socially optimal outcome.

IV. Discussion

The previous section showed, using a search model of the labor market, that deposit-refund schemes on labor reduce the natural rate of unemployment and increase the vacancy rate. The theoretical model employed to illustrate the argument is rather stylized. Below, some limitations of the proposed scheme are discussed.

First, it assumes that firms employ labor for a fixed number of hours rather than allowing for an endogenous work-hour choice. It can be easily demonstrated that firms facing a tax on firing workers—and fixed labor costs that are not too large—are likely to shorten working hours (as a substitute for adjustment of employment levels) when they are hit by an adverse productivity shock. Consequently, firms are likely to hoard labor during bad times causing productivity to move procyclically. Bertola (1990, 1992) uses a simple dynamic (partial) equilibrium model to show the stabilizing effect of firing costs on the average level of employment. Also, Abraham and Houseman (1993) find that German companies—which typically face stronger employment protection policies than U.S. enterprises—rely much more on the adjustment of average work hours, including the use of short-time work, to reduce total labor input during downturns.

Second, laborers are assumed to be working during their entire life, whereas in practice workers retire at a given age. If mandatory retirement did apply, firms employing workers up to the retirement age could keep the subsidies (received in the past) on currently retiring employees. In this way, hiring old (less productive) workers may be promoted. However, under a flexible retirement arrangement, firms may have an incentive to push old, unproductive workers into early retirement schemes to escape the burden of the firing tax.

Third, in practice, a lot of workers exit jobs through voluntary quits from which the model abstracts. If the worker terminates the employment contract, firms enjoy a larger net benefit—they receive a hiring subsidy without having to pay the firing tax—at the cost of

[17] For a Cobb-Douglas matching function it is easy to show that $\partial\Gamma/\partial\eta<0$, $\partial\Gamma/\partial\theta>0$ and $rdb/d\theta=\partial\Gamma/\partial\theta>0$. In this case, η is a constant so that optimality of the market equilibrium is a knife-edge property.

higher budgetary outlays to the government. Allowing for voluntary separations in the model creates a moral hazard problem: firms may abuse workers to induce them to quit (or even perhaps ask them to quit and share the gain with them) so that they do not have to pay the firing tax. However, the very existence of firing taxes may also give rise to moral hazard for employers: workers are more likely to shirk because firing costs make it more costly for firms to fire employees.

Finally, the job destruction process is exogenously given. As a result, the model cannot take into account firms' incentives to replace nonsubsidized employees by subsidized (the so-called displacement effect). However, allowing for an endogenous job destruction rate in a search model does not give clear analytical results. Mortensen and Pissarides (1998) show—using a variant of Pissarides' (1990) model in which job destruction takes place when idiosyncratic shocks reduce labor productivity below some reservation threshold—that the employment effect of an increase in hiring subsidies is ambiguous. On the one hand, the costs of job creation are reduced, stimulating job creation and increasing labor market tightness (lowering the average duration of an unemployment spell). On the other hand, a tighter labor market increases the reservation productivity threshold and thus raises job destruction (increasing the frequency of unemployment).

Besides these considerations, there are a number of other aspects, related to the practical relevance of the deposit-refund scheme in general, that merit further discussion. A major concern relates to the administrative feasibility of deposit-refund systems. A fundamental problem is that the scheme is subject to fraud: it can only become operational under the strong assumption that the government can distinguish quits from layoffs. Otherwise, a group of workers and employers can get together at the expense of the government. For example, an employee working at firm A quits and is subsequently rehired by firm B where an employee quits to be rehired by firm A. Even if quits could be distinguished from layoffs, the government needs to set up a monitoring system to ensure that firms laying off people make their deposit repayments. Monitoring costs are likely to remain limited when the number of participating firms in the scheme is not too large. In addition, an effective penalty system must be implemented to enforce compliance of firms with firing tax payments.

Opponents of active labor market policies could argue that subsidy-tax schemes on labor lead to rigidities in the labor market. An argument against job security provisions (i.e., a firing tax) is that firms are likely to freeze the average size of their workforce over the business cycle—through varying working hours—to avoid firing costs during downturns. This may delay or even cancel the sometimes needed efficiency-enhancing restructuring in enterprises. If firms cannot vary working hours, the deposit-refund scheme may exacerbate the variation of employment over the business cycle rather than dampening it (as is the case with a system of only firing costs). New and growing firms are expected to expand employment more than without the scheme because they receive the current subsidy payments on new workers whereas the expected firing costs in the future are discounted at a positive rate. Firing costs will not discourage hiring as long as the subsidy payments exceed the expected present discounted value of future firing costs. Restructuring firms, however, face immediate (undiscounted) firing costs if they cannot vary average working hours.

The matter of stock versus flow subsidies deserves attention. A *generalized application* of the deposit-refund scheme would require a one-off lump-sum tax at introduction to finance ex post disbursement of employment subsidies on the current stock of workers. If governments have to resort to distortionary labor taxes, the employment effect on impact depends on whether the boost to economic demand from subsidy disbursement dominates the negative employment effect of labor taxation. Once the funds are raised to establish the deposit-refund system, it will operate on a budgetary neutral basis in the steady state—given the assumptions set out in the theoretical section—because the inflow of workers matches the outflow. In practice, in evaluating the budgetary implications, the government should also take into account the saved unemployment benefits that it otherwise would have provided to unemployed workers and the lost resources on workers who voluntarily quit. Alternatively, the deposit-refund scheme could be introduced *at the margin* in the sense that it would only apply to newly created jobs (a so-called recruitment subsidy) or those jobs created above a given reference level of employment. Also, the government may opt to restrict the scheme to certain categories of employment such as low-skill jobs or to particular sectors of the economy. Applying the deposit-refund scheme at the margin to targeted groups significantly saves on the budgetary outlays needed to set up the system compared with an across-the-board application.

The deposit-refund scheme fails to be budgetarily neutral in steady state when firms go bankrupt: there is no way to recoup the revenues from firing taxes on the workforce laid off. Therefore, in transition economies, featuring a large share of restructuring firms, these schemes have limited practicability as an instrument to stimulate employment. Typically, the scheme could be applied to sectors of advanced economies in which the government considers the rate of labor turnover to be "socially excessive" to motivate employers to retain and train their workers. Some industries facing very uncertain final demand patterns—mirrored in their labor demand—may need to be exempted from the scheme.

The theoretical model assumed that the hiring subsidy and firing tax were equal. This makes perfect sense for commodities with a high rate of turnover such as bottles and car batteries. However, if turnover is low—in the case of labor, a worker may be employed at a firm for 40 years—and deposit rates are not indexed for inflation, it is not a priori clear whether this is an optimal strategy.[18] In an inflationary environment, firms receive a larger net real benefit when a match dissolves (the real value of the firing penalty is below the real value of the hiring

[18] Even though the optimal deposit rate could be determined in theory, ascertaining the optimal rate in practice may not be an easy task because estimates of the net marginal social costs of unemployment are not readily available.

subsidy) at increased net real costs to the government. Observers may claim that this provides a rationale—in addition to voluntary quits and retirement—for a firing tax greater than the hiring subsidy. In general, the following rule should apply: the difference between the firing tax and the job creation subsidy must be greater than or equal to zero; otherwise, the firm could earn unbounded returns by choosing a very high level of labor turnover.

V. Conclusion

Firms firing workers impose costs upon society in terms of unemployment benefits, retraining, and other labor market measures. The formal literature on active labor market policies has suggested using (marginal) employment subsidies or hiring subsidies as one way to deal with the problem of unemployment. This paper explores a new policy strategy—a subsidy-tax scheme on labor—as an alternative to budgetary costly employment subsidy schemes. It is shown—using a simple search-theoretic model of the labor market—that if a firm pays a tax when it fires a worker to be reimbursed when it (re)hires that or another worker, the economy-wide wage goes up, the natural rate of unemployment declines and the vacancy rate increases.

Theoretically, a deposit-refund scheme seems to be a useful policy instrument to reduce the equilibrium rate of unemployment, but there are some limitations to its appeal. First, it could be argued that it creates additional rigidities in the labor market because employers may want to stabilize their average labor force—possibly through varying the average hours worked per person—out of fear for firing costs during downturns. Consequently, efficiency-enhancing restructuring in firms through massive layoffs may be delayed. However, the scheme could potentially be implemented at the margin—applying only to new recruits above a certain threshold—in sectors or employment categories where governments want to motivate employers to retain and train their employees. Second, it could create moral hazard: firms experiencing bad business conditions may try to push employees into voluntarily quitting rather than firing them. However, employees with permanent contracts may be encouraged to shirk more as firing them becomes more costly to the firm. Third, there is no way of recouping firing taxes from firms going through bankruptcy procedures. Finally, the deposit-refund scheme is susceptible to fraud; because the government is unable to distinguish quits from layoffs, firms and employees may get together at the expense of the government. Even if the government could distinguish quits from layoffs, the scheme is administratively demanding because a monitoring plus penalty system needs to be in place to enforce compliance with firing tax payments.

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